BOOK REVIEWS

SEDIMENTARY ROCKS, By F. J. Pettijohn.

In this imposing and useful work Dr. F. J. Pettijohn, Professor of Geology at the University of Chicago, has attempted to encompass the fields of sedimentary petrology and petrography, rather than that of sedimentation. He succeeds to the extent that the volume will undoubtedly, in a short time, become one of the outstanding textbooks and reference works in its chosen field. Albeit the book lacks competition, nevertheless it develops a powerful summary of the properties, characteristics, and origins of sedimentary rocks, an orphan group that has long suffered the general neglect of petrologists.

The book is the seventh in the Geoscience Series published by Harper and Brothers and edited by Carey Croneis. It contains 526 pages in 15 chapters, 131 figures, 40 plates, 139 tables, and both an author and a subject index. The price is $7.50. One of the outstanding features is the profusion of excellent and pertinent illustrations that it contains. For the first time in a textbook the plates have been reproduced by the collotype process, which has provided results of unusual clarity. The 104 photomicrographs are particularly aptly chosen to illustrate in effective detail microscopic textures and structures, some of which are shown for the first time in a text of instructional character. The 40 other photographs, of handspecimens and outcrops, have likewise been carefully selected and prepared.

A short introductory chapter is followed by one on textures. From the ideal standpoint the arrangement of subject material might well have been initiated with the section on composition, for to discuss the arrangement and interrelations of material particles it is desirable to know first of what those particles consist. Under texture are included discussions of size, size frequency distribution, textural classifications, size analysis interpretation, shape, roundness, grain surfaces, fabric, packing, porosity, permeability, and nonclastic textural features. This is by many pages the largest chapter in the book (73 pages). Indeed the descriptive minutiae of textural analysis into which it delves foreswears somewhat the statement in the editor's introduction that the writer "regards this volume as an elementary treatment."

The chapter on composition treats first the chemistry and then the mineralogy of sedimentary rocks and closes with a brief discussion of radioactivity in sediments. It is strange to see that bauxite apparently is given status as a true mineral (table 29, p. 107), whereas limonite is used correctly, i.e., in quotation marks, in the same table. As discussed in the 7th edition of the Dana System on page 667, bauxite is a mixture containing several aluminous minerals. Under properties to be employed in distinguishing quartz from feldspar (p. 93) noteworthy omissions are the recognition of feldspar by its common turbid alteration and quartz by its clarity and "trains" of minute inclusions. In table 31, p. 110, a description of the carbonate minerals, twinning is stated to be absent in dolomite.

Sedimentary structures described in chapter 4 are subdivided into inorganic and organic, the former further into mechanical and chemical structures. Outstanding parts of this chapter include a thorough discussion of bedding and of the petrology of fossils. There follows a short chapter on color, which contains among other things, a summary of prevailing thought on red beds and their origin. According to Pettijohn, they "may originate under intermittently rainy, subarid, or arid climates without any close relation to temperature. They are typically fluvial or pluvial deposits upon the land, though to a limited extent they are fluviatile deposits coming to rest on the bottom of a shallow sea" (pp. 173–174). No mention is made in this section of such features as the color mottlings of carbonate rocks produced by partial dolomitization or of secondary concentric color bands formed in joint blocks in sandstones.

Chapter 6, on the classification of sedimentary rocks, begins with synopses of Grabau's and Krynine's classifications and concludes with an equitably restrained treatment of the

graphic representation of sedimentary rocks by means of five compositional variables: M, stable primary detrital minerals, commonly quartz; N, stable secondary detrital minerals, usually clay minerals; X and Y, chemical components, such as carbonates and silica; and Z, any other nonclastic constituent, perhaps carbon. By means of such a scheme and its applications to 2-, 3-, and 4-component diagrams, it is believed that 95% of all sedimentary rocks can be represented adequately.

Next follows a group of five chapters, each describing a group of related rock types: conglomerates and breccias, sandstones, shales and argillites, limestones and dolomites, and non-clastic sediments. In this section probably lies the main strength of the book, for the descriptions of rock compositions and textures, as well as the discussions of their origins, are pellucid and coherent. Some rocks, for example, graywacke, are adequately treated probably for the first time. The controversial literature on these rocks is critically examined and distilled to dovetail with the facts of their occurrence and composition. Throughout the descriptive chapters are presented many new data, garnered through years of careful observation.

The final group of four chapters is concerned with processes: weathering, transportation, deposition, and lithification and diagenesis. The author in his preface states " . . . much of what is ordinarily considered 'sedimentation' is omitted. Many of the transient phenomena . . . leave no record and can best be left out." This restriction probably enhances the value of the book, for it leaves more space for descriptions of the rocks themselves, with which the geologist is required to deal. The reviewer is in complete accord with Professor Pettijohn's declaration that in sedimentary rocks "thin-section studies must be the main basis for investigation rather than the exception."

Like all first editions, the book has defects, none of them serious and some, no doubt being rooted in the training and inclinations of its reviewer. A slight lack of balance is apparent, due possibly to the author's particular devotion to specialized aspects of his subject. The part on analytical methods applicable exclusively to unconsolidated materials seems excessive, especially in view of its limited usefulness. Some features and types of sedimentary rocks are discussed not at all or but inadequately; to name some examples: oil shales and kerogen, bauxite, vanadiferous phosphatic rocks, bentonite, and dolomitization. Typographical and proof errors are, of course, almost impossible to eliminate entirely, but the book appears to have a relatively large share. Some of those noted in a cursory hunt are: p. 77, A. J. Eardley reference is listed in the author index as appearing on p. 75; p. 106, G. Palache for C. Palache in the footnote; this error also appears in the author index; nor is the edition number given for the Dana System; p. 265, alternation for alteration; p. 341 maybe for may be; p. 354 phosphorous for phosphorus; and p. 376, Weyland for Wayland.

These defects are, in the main, minor and do not seriously detract from the general high standard of the book. Professor Pettijohn is to be congratulated on producing in its initial edition a quality work of fundamental importance to sedimentary petrologists. It is a book that most petrographers will wish to acquire after perusal and to peruse again after acquisition.

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RADIOACTIVE MEASUREMENTS WITH NUCLEAR EMULSIONS, By Herman Yagoda.

There is much of interest to mineralogists and crystallographers in "Radioactive Measurements with Nuclear Emulsion" by Herman Yagoda. Other parts of this 356-page book are directed toward physicists, biologists, chemists, and metallurgists. Because of

relatively recent improvements in the development of special emulsions, the photographic process is once more proving valuable for recording and investigating radioactive emanations. The author has described the techniques and summarized their application in the various fields. In the preface he notes that every basic advance in our knowledge of radioactivity, such as the discovery of protons from radioactive decay or the recording of both light and heavy mesons, has been brought about through photographic detection methods.

The initial chapter opens with a historical review of the process of photographic nuclear particle detection and is followed by sections that discuss chemical reactions with emulsions, emulsion effects due to phosphorescence, to hydrogen peroxide produced, for example, by the oxidation of freshly abraded metal surfaces in moist air, to chromic acid, and to pressure. Other parts of this chapter deal with the nature of the image produced and of the autoradiographic mechanism. In chapter two the photographic and scintillation methods are compared. Of special importance to mineralogists are those parts of chapter 3 dealing with preparation of polished pieces of radioactive minerals, the mechanics of image production, and the techniques of image examination.

Then follow two chapters on the patterns produced by alpha particles on nuclear emulsions and the quantitative aspects of such patterns. The parts of the book that deal specifically with the use of the autoradiograph technique in mineralogy and crystallography are found in chapter 7 and in the first half of chapter 8. Sample topics treated here include determination of the uranium and thorium contents of minerals, a discussion of radiocolloids in geochemistry, discovery of radioactive minerals grains, and detection of rock radioactivity (1000 hours exposure). Data on the growth of crystals can be secured by mixing traces of radioactive ions in the mother solution and periodically allowing the radioactive zones to register on nuclear emulsions. The internal structure of radioactive minerals also can be recorded, and intergrowths of minerals with different contents of radioactive elements or of radioactive and non-radioactive grains can be detected.

The remainder of the book, chapters 11 and 12, is of lesser importance to students of crystallography and mineralogy, although brief mention is made of the application of the records of beta radiation to crystal study and of autoradiographic studies of minerals activated by neutron bombardment.

The book concludes with a valuable bibliography of 656 references, including 20 by the author himself, and two appendices: (1) Range-energy relations in Ilford nuclear research emulsions and (2) Atomic constants and conversion factors.

This volume represents the first published compilation of theoretical and technical information on methods of studying and measuring radioactive emanations by means of emulsions of the nuclear type. As such it should prove a valuable source book to scientists employing these devices and stimulate their further and wider application. The book is clearly and simply written. Individual chapters are somewhat heterogeneously organized, alternating between sections on practical technique and portions on theory, which leads to lack of continuity. The 75 figures, both line drawings and half-tone reproductions, are clear and pertinent. John Wiley is the publisher, and the cost is $5.00.

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REPORT OF THE COMMITTEE ON THE MEASUREMENT OF GEOLOGIC TIME, 1947–1948, by John Putnam Marble, Chairman. Presented for publication to Division of Geology and Geography, National Research Council, March 1949. Price $1.00. 77 pages.

This is the tenth mimeographed report of the Committee on Measurement of Geologic Time. The first report was issued in September 1936. Alfred C. Lane served as Chairman of

the Committee of the first eight reports while the ninth and tenth were prepared under the chairmanship of John Putnam Marble. Some idea of the scope and character of the last report may be gained from a glance of the Contents with its six main headings, characterized as "Exhibits" which are enumerated below.

Contents

In Memoriam: Alfred Church Lane, 1863–1948
Summary Report of the Committee on the Measurement of Geologic Time for 1947–1948, by John Putnam Marble, Chairman
Supplementary reports, presented as Exhibits:
Exhibits:

A. Report from Dr. Arthur Holmes, University of Edinburgh
B. The Necessity for Different Values for the Ratio Pb/U of the Crust and the Rest of the Planet, by Sr. Dn. Dr. Juan Manuel López de Azcona (translated by A. H. Marble and J. P. Marble)
C. Review of Work in Japan, by John Putnam Marble
D. Archaeological Ages by Natural Radiocarbon Content, by Dr. W. F. Libby, with Comments by R. F. Flint
E. Preliminary Report on Determining the Age of Rocks by the Lead-Uranium Ratio of Zircon, Apatite, and Sphene from the Rocks using Alpha counting and Spectrographic Methods by E. S. Larsen, Jr., N. B. Keevil and H. C. Harrison
F. Annotated Bibliography of Articles Relating to the Measurement of Geologic Time compiled by J. P. Marble

List of Available Reports of the Committee

Anyone interested can obtain a copy of this Report by payment by check, draft or money order drawn in favor of the National Academy of Sciences, but mailed with order to the Division of Geology and Geography, National Research Council, 2101 Constitution Ave., N. W., Washington 25, D. C. Copies of the annual reports of the same Committee for the years 1935–36, 1936–37, 1937–38, 1938–39 and 1940–1941 available without charge; for 1941–42, 1942–43 at 50¢ each, and 1943–46, 1946–47 at $1.00 per copy. Complimentary copies (1 each) of these reports (while available, and unless previously sent) can be furnished to Libraries of educational institutions.

W. F. H.

DAS BESTIMMEN DER MINERALIEN, by Alexander Köhler, pp. v+150, 23 illustrations, octavo. Springer-Verlag, Vienna, 1949.

In these tables an attempt is made to combine the use of the optical constants and newer chemical methods, as developed by Feigl and Leitmeier, with the physical and chemical properties which can be readily determined at sight or by simple methods.

The author, who is professor of mineralogy at the University of Vienna, expresses the belief that these tables are superior to those of Weisbach-Kolbeck and Fuchs-Brauns which have long been in successful use. Eight pages are devoted to a brief discussion of the various physical properties, which are easily recognized or determined. In 20 pages blowpipe and the Feigl-Leitmeier chemical reactions are described and summarized. Simple optical determinations are very briefly mentioned in less than 4 pages. An outline of the procedure to be followed in using the tables, and 23 crystal drawings and diagrams of the extinction angles of some of the feldspars and members of the hornblende and augite groups conclude the first portion of the book, which comprises 41 pages.

In the tables, which cover 104 pages, minerals are arranged in groups according to

luster, color, and increasing hardness. Streak, crystallization, and other diagnostic properties are listed, as well as the mineral associates and occurrences.

These tables will undoubtedly find considerable use among students and others competent in the German language.

EDWARD H. KRAUS

COPPER IN CALIFORNIA (1948), by the State Division of Mines, 429 pages, accompanying map pocket, *Bulletin 144* of the Division of Mines publications.

Bulletin 144, entitled Copper in California, was recently released by the California Division of Mines and should prove of considerable interest to mining engineers, geologists, and mineralogists. Much of importance has occurred, both economically and geologically since the last copper publication, Bulletin 50, now out of print.

While no specific publication has been issued by the Department strictly upon the subject of copper for a number of years, the regular bulletins dealing with mining generally have devoted much attention to the activities of the copper mining industry. However, this information is not always readily available, and Bulletin 144 tabulates all previous publications, and records pertinent data on each copper property.

This new bulletin is divided into three parts, and is accompanied by an elaborate series of maps, the latter being in a specially-bound map pocket, which is separate from the printed volume. Part 1 is devoted principally to a study of the noted California Foothill Copper Belt; Part 2 affords a comprehensive presentation of marketing and metallurgical factors as related to the complex copper-bearing ores, while Part 3 summarizes the data upon copper production, discusses generally the distribution, mineralogy, and geology of California copper deposits, and includes an excellently tabulated list of California copper occurrences.

The major portion of the volume consists principally of contributions by the United States Geological Survey and the Bureau of Mines, based upon strategic mineral investigations. One of the most valuable features of the volume is a carefully selected and detailed bibliography; the index is likewise exceedingly complete. It will stand as a milestone of progress in presenting the history, geology, economics and future of the California copper occurrences. Appearing as it does, in California's Centennial year, adds interest to the volume.

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